

COMPARATIVE VERSUS CONTRIBUTORY NEGLIGENCE: A COMPARISON OF THE LITIGATION EXPENDITURES

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Abstract

The previous literature on comparative and contributory negligence points out that administrative costs are higher under comparative negligence because the courts must decide on the degree of negligence by both parties and not just whether the parties were negligent. In this article, I show that this finding is not necessarily correct. I use a rent seeking model to show that the litigation expenditures may be smaller under comparative negligence. The previous literature has focused on only one effect, while there may be three effects at play.

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1. Introduction

In the United States as well as in Europe, comparative negligence rather than contributory negligence is the general rule in tort law (see Artigot i Golobardes and Gomez Pomar, 2009).¹ Comparative negligence divides the cost of harm between the parties in proportion to the contribution of their negligence to the accident. Under a rule of (negligence with a defense of) contributory negligence, the negligent injurer can escape liability by proving that the victim's precaution fell short of the legal standard of care (see Cooter and Ulen 2003). Although these negligence rules have been examined quite extensively in the law and economics literature, it is still debated whether comparative negligence creates better incentives for parties to adopt efficient care than contributory negligence (see e.g. Artigot i Golobardes and Gómez Pomar 2009; Bar-Gill and Ben-Shahar 2003). The early literature concluded that contributory negligence is more efficient (e.g. Brown 1973; Diamond 1974; Posner 1977).² Later it was shown that both rules are equivalent from an efficiency perspective when information is perfect and decision-makers are error-free (e.g. Haddock and Curran 1985; Shavell 1987)³, but that the equivalence does not hold when these assumptions are relaxed (e.g. Haddock and Curran 1985; Cooter and Ulen 1986).⁴ At first, relaxing the assumptions seemed to favor comparative negligence, but more recent literature is rather sceptical concerning any general superiority of one of these liability regimes (e.g. Bar-Gill and Ben-Shahar 2003).^{5 6}

¹ In the US, negligence with contributory negligence was the dominant tort-liability rule in common law countries for most of the last 200 years. This changed however within the last 40 years. The prevailing liability standard in all but a few of US states is one of comparative negligence. Most civil law jurisdictions in Europe adopted the principle of comparative negligence long before the US made this change.

² For example, Brown (1973) states that with comparative negligence, the costs of accidents are shared between injurer and victim, so neither of them bears the full costs of failing to take optimal care. Consequently, both parties may be induced to take less care than is optimal.

³ The reason is that under both rules, if parties of one type take due care, then parties of the other type will reason that they alone will be found negligent if they do not take due care (see Shavell 2004). Note that it is assumed that due care is set at the optimal level.

⁴ Cooter and Ulen (1986) show that under conditions of evidentiary uncertainty, comparative negligence gives moderate incentives to deviate from the standard of care to both parties. Contributory negligence gives the strongest incentives to one party and the weakest incentives to the other. Comparative negligence is then the most efficient rule because it minimizes the total amount of deviation from due care when parties are symmetrically situated.

⁵ Note that some articles show that comparative negligence provides better incentives to take efficient care levels than negligence or contributory negligence when injurers as well as victims are heterogeneous (see Emons and Sobel (1991) and Feess and Hege (1998)) or when parties make precaution decisions sequentially (see Rea (1987) and Grady (1990)).

⁶ Bar-Gill and Ben-Shahar (2003) challenge the assumption that parties are symmetrically situated: one party could be better situated to take care. Also, they show that small intermediate deviations are not necessarily preferred to large deviations which may result from other liability rules (they use computer simulations to show this). Note that some empirical studies point out that comparative negligence weaken incentives to take

This ongoing debate stands in contrast to the lack of conflicting opinions with respect to the relative size of the administrative costs under both negligence rules. Comparative negligence is generally considered to generate higher costs per case. Landes and Posner (1987) observe that comparative negligence costs more to administer than contributory negligence. Shavell (1987) states that the defense of contributory negligence may lead to less complicated proceedings compared to comparative negligence. White (1989) argues that comparative negligence seems to generate higher litigation and administrative costs than the traditional negligence rules because the courts must decide on the degree of negligence by both parties and not just whether the parties were negligent. Bar-Gill and Ben-Shahar (2001) state that contributory negligence might be cheaper to administer than comparative negligence.⁷

The point of view that comparative negligence entails higher costs per case is obviously true in a setting with exogenous litigation costs. The additional element of weighing the parties' degree of negligence indeed generates extra costs. However, the previous literature has overlooked the fact that different effects (more precisely, three) are at play in a more realistic setting in which litigation costs are endogenous.⁸ We show that in such a setting, comparative negligence can be less costly than contributory negligence. The kernel of the argument can be explained with a simple numerical example. Suppose (for simplicity) that the defendant's negligence is certain and that the parties share the loss (J) equally when also the plaintiff is held liable. The plaintiff can make an additional investment⁹ to increase his chances of not being held liable from 20% to 50%.¹⁰ Under a rule of contributory negligence, the marginal benefit from this extra investment equals $0.5.J - 0.2.J = 0.3.J$. Under a rule of comparative negligence, the marginal benefit of the extra investment is smaller: $(0.5.J + 0.5.J/2) - (0.2.J +$

precaution (see White 1989), is associated with higher automobile liability insurance premiums (see Flanigan, Johnson, Winkler and Ferguson 1989), and increases binge drinking (see Sloan, Reilly and Schenzler 1995). According to Dari-Mattiacci and De Geest (2005), the current empirical literature does not allow us to make any statements on whether comparative negligence worsens the parties' incentives. Although there can be more accidents under comparative negligence, injurers who exercise care have, on average, lower care costs. In other words, under comparative negligence, there are more accidents, and less is spent on precaution, but what is spent on precaution is relatively well spent. Some of the empirical studies need to be interpreted with care for other reasons as well. For example, Flanigan et al. (1989) find that comparative negligence is associated with higher automobile liability insurance premiums, but they did not investigate whether this increase was due to more accidents or to more claims toward injurers.

⁷ Note further that the alleged risk-spreading virtue of comparative negligence is questionable. Given the availability of third-party insurance, there are better alternatives available to spread the risk of accidental harm (see White 1989).

⁸ Many relatively recent accounts of litigation stress the importance of treating litigation expenditures as endogenously determined. See for example Sanchirico (2006).

⁹ This is an investment in more or better lawyering services once a trial is imminent or has begun.

¹⁰ These numbers are merely illustrative.

$0.8J/2) = 0.15J$. Clearly, the benefit is smaller under a rule of comparative negligence. Intuitively, the stakes are higher under contributory negligence: if the plaintiff is held liable, he pays everything. Under comparative negligence, he only bears half of the harm. While the expenditures of the parties concerning the *liability of the plaintiff* are larger under contributory negligence, we can easily show that the expenditures concerning the *liability of the defendant* are larger under comparative negligence. Another numerical example can easily demonstrate this. Suppose that this time the plaintiff's negligence is certain and that once again the parties share the loss equally when also the defendant is held liable. The plaintiff can make an extra investment to increase the probability that the defendant will be held liable from 20 % to 50%. Under a rule of contributory negligence, the marginal benefit from this extra investment equals 0 (since the plaintiff will bear the full loss, no matter whether the defendant is found negligent or not). Under a rule of comparative negligence, the marginal benefit of the extra investment is larger: $0.3J/2$. Intuitively, when it comes to the negligence of the defendant, the stakes are higher under comparative negligence. Note that things are more complex than this. Under comparative negligence the expenditures may also influence the court's perception of the degree of negligence and this may determine the division of the loss under this negligence rule. We incorporate this in the general model. We find a relatively simple condition for the case in which the total expenditures are smaller under comparative negligence than under contributory negligence. We will see that especially for high-quality claims, comparative negligence may lead to lower litigation costs than contributory negligence.¹¹ I stress that this article deals with one particular aspect of the relative efficiency of contributory and comparative negligence, namely their relative costs at trial. It does not address the overall efficiency of the two negligence standards.¹²

We will proceed as follows. The following section provides a general model which incorporates contributory negligence and comparative negligence.¹³ Section 3 compares the litigation expenditures for contributory and comparative negligence. Section 4 concludes.

¹¹ By this we mean that the inherent degree of fault of the defendant is large and the inherent degree of fault of the plaintiff is low.

¹² The model does not directly suggest how potential injurers and victims might react in their precautionary decisions.

¹³ Note that we will focus on the pure comparative negligence rule, and not on modified forms (e.g. the '50 percent rule'). A modified rule bars a negligent plaintiff's recovery when the plaintiff's fault exceeds a certain level in comparison to the defendant's fault. Otherwise the rule allocates damages based on the relative negligence exhibited by each (like pure comparative negligence).

2. Model

As mentioned in the introduction, comparative negligence divides the cost of harm between the parties in proportion to the contribution of their negligence to the accident. Under a rule of contributory negligence, the negligent injurer can escape liability by proving that the victim's precaution fell short of the legal standard of care. More formally, we can describe the judgment under comparative negligence as follows:

$$L(x,y) = \begin{cases} 0 & \text{if } x \geq x^* \\ 1 & \text{if } x < x^* \text{ and } y \geq y^* \\ \sigma & \text{if } x < x^* \text{ and } y < y^* \text{ (with } 0 < \sigma < 1) \end{cases}$$

with x the level of care of the defendant, x^* the optimal level of care of the defendant, y the level of care of the plaintiff, y^* the optimal level of care of the plaintiff and σ the plaintiff's share if both parties are considered liable. By assumption, the plaintiff has suffered harm of 1.¹⁴

Likewise, we can describe contributory negligence formally as follows:

$$L(x,y) = \begin{cases} 0 & \text{if } x \geq x^* \\ 0 & \text{if } x < x^* \text{ and } y < y^* \\ 1 & \text{otherwise} \end{cases}$$

At trial, both parties choose their level of spending on legal assistance.¹⁵ There are two choice variables on each side: the litigation effort regarding the negligence of the defendant and the litigation effort regarding the negligence of the plaintiff. Both parties are assumed to be risk-neutral. Each contender aims to maximize his expected income. Each party is assumed responsible for her own legal costs regardless of the outcome (the American rule thus applies). The Litigation Success Functions¹⁶ incorporate the insight that in lawsuits, relative

¹⁴ Note that (for example) $x < x^*$ needs to be read as: *the court considers* the defendant's amount of care to be lower than the optimal amount of care. In the model of this paper, the expected award does not only depend on the levels of care of the parties (which play their role in the model through F , the inherent merit of the case, see further), but also on the expenditures of the parties.

¹⁵ For the sake of completeness, the appendix provides the participation constraints of the parties. As we focus in this article on the expenditures once a trial has begun, we do not elaborate on these constraints.

¹⁶ One for the defendant's negligence and one for the plaintiff's negligence (see further).

success depends on the true degree of fault (or the exogenous merits) and on the efforts invested on each side. If the defendant took an amount of care that is much smaller than the level of due care, the true degree of fault of the defendant will be high.¹⁷ The true degree of fault is assumed to be a value between 0 and 1. Regarding the defendant's negligence, a true degree of fault of 0 means that the defendant will never lose that issue, no matter how much the other side spends. A true degree of fault of 1 means that the plaintiff will always win the issue, no matter how much the defendant spends. For any other true degree of fault, either party always has a positive probability of winning the issue. Regarding the plaintiff's negligence, a true degree of fault of 0 means that the plaintiff will always win that issue, no matter how much the other side spends. A true degree of fault of 1 means that the defendant will never lose that issue. The true degree of fault of each issue (the defendant's and plaintiff's negligence) is known by both litigants but is not known by the court. The plaintiff and the defendant choose their strategies simultaneously and we look for the Nash equilibrium of this game. The parties have equal stakes and have common knowledge of all the underlying functions and parameters (the actual level of fault, the amount at stake etc.). For the sake of simplicity, the amount at stake is set equal to 1.

Using a standard contest function¹⁸, the probability that the defendant will be held negligent by the court equals:

$$P_d = \frac{X_1 F_1}{X_1 F_1 + Y_1 (1 - F_1)} = \frac{1}{1 + \left(\frac{Y_1}{X_1} \right) \left(\frac{1 - F_1}{F_1} \right)}$$

where X_I equals the expenditures of the plaintiff for the liability of the defendant, Y_I equals the expenditures of the defendant for the liability of the defendant and F_I is the true degree of fault of the defendant ($0 \leq F_I \leq 1$).¹⁹

¹⁷ Or phrased alternatively, the exogenous merits of the plaintiff's claim regarding the defendant's negligence will be high.

¹⁸ Identical or similar functions are used by Katz (1988); Farmer and Pecorino (1999) and Hirshleifer and Osborne (2001). Konrad (2009) discusses this type of contest function (the "Tullock contest function") in detail. The author thoroughly explains why this function has been used in so many different areas of applied theory. The function can be derived from axiomatic reasoning and has micro-economic underpinnings as well.

¹⁹ Note that $\frac{\partial P_d}{\partial X_1} > 0$; $\frac{\partial P_d}{\partial Y_1} < 0$; $\frac{\partial^2 P_d}{\partial X_1^2} < 0$; $\frac{\partial^2 P_d}{\partial Y_1^2} > 0$.

As mentioned before, the Litigation Success Function incorporates the insight that the outcome of a lawsuit depends on the true degree of fault and on the efforts of the parties. An example may illustrate this. Suppose the defendant took an amount of care that is substantially lower than the due level of care. Then his true degree of fault will be high (e.g. $F_1=0.8$). However, this does not *automatically* imply that the probability that he will be held negligent is high. If the defendant spends much more than the plaintiff ($Y_1 \gg X_1$; e.g. the defendant invests heavily in looking for legal arguments why he shouldn't take due care; or he invests in misrepresenting facts so that it looks like he may have taken due care etc.), then the ultimate probability of victory for the plaintiff may be relatively low.

Similarly, the probability that the plaintiff will be held negligent by the court equals:

$$P_p = \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1 - F_2)}$$

where X_2 equals the expenditures of the plaintiff for the liability of the plaintiff, Y_2 equals the expenditures of the defendant for the liability of the plaintiff and F_2 is the true degree of fault of the plaintiff ($0 \leq F_2 \leq 1$).²⁰

Note that both P_p and P_d can take on any value between 0 and 1. I stress that both parties have the same estimate of P_p and the same estimate of P_d (there are no divergent expectations; more formally: $P_p^{pl} = P_p^{def}$ and $P_d^{pl} = P_d^{def}$). Note also that there's no systematic relationship between P_p and P_d (e.g. their sum is not equal to one). The reason is that P_p and P_d are differently defined as is typical in the economic analysis of civil procedure. In the model of this article, P_p and P_d concern the estimates of two different issues (the probability that respectively the plaintiff and the defendant will be held negligent), not the overall estimates that the plaintiff will win at trial.²¹

Under *contributory negligence*, the plaintiff's expected value equals:

²⁰ Note that $\frac{\partial P_p}{\partial X_2} < 0$; $\frac{\partial P_p}{\partial Y_2} > 0$; $\frac{\partial^2 P_p}{\partial X_2^2} > 0$; $\frac{\partial^2 P_p}{\partial Y_2^2} < 0$.

²¹ Traditionally, P_p and P_d represent the subjective probabilities of the plaintiff and the defendant that the plaintiff will win at trial. In our model, P_p represents the estimate of both parties that the plaintiff will be held negligent, and P_d represents the estimate of both parties that the defendant will be held negligent.

$$EV_{pl} = P_d(1 - P_p) - X_1 - X_2$$

The first term, $P_d(1 - P_p)$, represents the situation in which the defendant is held negligent (probability P_d) but the plaintiff is not (probability $1 - P_p$). Indeed, under contributory negligence, the plaintiff will only be awarded the amount at stake under these circumstances.²² The latter terms represent the plaintiff's expenditures (regarding respectively the defendant's and the plaintiff's negligence).

Similarly, the defendant's expected loss under contributory negligence equals:

$$EL_{def} = P_d(1 - P_p) + Y_1 + Y_2$$

Under *comparative negligence*, the expected value of the plaintiff's claim equals:

$$EV_{pl} = P_d(1 - P_p) + P_p P_d \sigma - X_1 - X_2$$

The first term, $P_d(1 - P_p)$, represents the situation in which the defendant is held negligent and the plaintiff is not. In that case, the plaintiff is awarded the amount at stake. The second term, $P_p P_d \sigma$, represents the situation in which both parties are held negligent. In that case, the plaintiff only receives partial compensation ($0 < \sigma < 1$). The last two terms represent the expenditures of the plaintiff (regarding the defendant's negligence and the plaintiff's negligence).

Obviously, the plaintiff's share σ in case both parties are held negligent will depend on the true degrees of fault and on the expenditures of the parties. For example, even though the true degree of fault of the defendant may be large (F_1 is large) and the true degree of fault of the plaintiff may be small (F_2 is small), the plaintiff's share in case both parties are held negligent may still be relatively small if the defendant spends a lot on convincing the court that his degree of fault was not so high, and/or that the degree of the plaintiff's fault was relatively

²² For the sake of simplicity, we assume the amount at stake to be fixed. The expenditures only influence the probability of winning, not the amount at stake.

high.²³ We will assume that the anticipated division of the loss among the parties is a function of the relative probabilities of victory (which themselves depend on the exogenous merits and the expenditures of the parties):

$$\sigma = \frac{P_d}{P_d + P_p} = \frac{1}{1 + \frac{P_p}{P_d}}$$

The intuition behind this is as follows.²⁴ The probabilities of victory incorporate information about the (parties') estimates of the court's ultimate view on the plaintiff's and the defendant's degree of fault. For example, if the plaintiff thinks there's an 80 percent chance that the court will hold him negligent, he will expect that – in the actual case that the court considers him to have acted negligently – the court will consider his degree of negligence to be larger than when he thinks that there's only a 20 percent chance of being held negligent by the court.

We can illustrate the difference between contributory and comparative negligence with a simple example. Suppose for simplicity that the defendant could have driven at three possible speeds: 120 km/h (due care), 130 km/h or 140 km/h. The plaintiff has already hired one expert who will argue that the defendant drove 130 km/h. Now he faces the choice of hiring an extra expert, who will argue that the defendant drove 140 km/h. Under contributory negligence, hiring the extra expert influences the plaintiff's expected value by increasing his probability of winning.²⁵ For example, if $F=0.7$, hiring one expert costs 10, hiring two experts 20, and the defendant has chosen to hire one expert at a cost of 10 (who will argue that the defendant drove 120 km/h), then hiring two experts instead of one increases the plaintiff's probability of

²³ Of course in reality, not all expenditures will have an impact on the way the court perceives the degree of fault of a party (e.g. whether a statute of limitations applies). On average however, larger expenditures of a party will increase the probability that the court will consider that party's negligence as less serious.

²⁴ Note however that also with a more general function $\sigma(X,Y)$ – with $\partial\sigma/\partial X > 0$ and $\partial\sigma/\partial Y < 0$ – it would be possible to prove that the expenditures regarding the plaintiff's negligence may be smaller under comparative negligence than under contributory negligence, and that the expenditures regarding the defendant's negligence are always larger under comparative negligence. Note also that more complicated formulas could be used, e.g.

$$f \frac{1}{1 + \left(\frac{P_p}{P_d}\right)^z}.$$

²⁵ For example, the court may be convinced more easily that the defendant did not take due care (120 km/h) if another expert argues that the defendant drove 140 km/h.

winning from 70 % (7/10) to 82 % (14/17). Under comparative negligence, hiring the extra expert also influences the plaintiff's expected value by increasing the average plaintiff's share in case both parties are found negligent. Suppose $P_p=0.5$. Then the plaintiff's average share increases from 0.58 (0.7/1.2) to 0.62 (0.82/1.32).

Turning from the plaintiff's expected value to the defendant's expected loss under comparative negligence, we obtain in a similar way:

$$EL_{def} = P_d(1 - P_p) + P_p P_d \sigma + Y_1 + Y_2$$

If we now fill in the formulas (contest functions) for P_p and P_d in the plaintiff's expected value and the defendant's expected loss, we obtain the following Nash equilibria²⁶:

$$X_1^* = Y_1^* = F_1(1 - F_1)(1 - F_2) + F_1(1 - F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right]$$

$$X_2^* = Y_2^* = F_1 F_2 (1 - F_2) \left(1 - \frac{F_1}{F_1 + F_2} \right) \left(1 - \frac{F_2}{F_1 + F_2} \right)$$

3. Comparison of comparative and contributory negligence

3.1. Expenditures regarding the defendant's negligence

Under contributory negligence, the parties' expenditures regarding the defendant's negligence equal²⁷

²⁶ The interior solutions may not constitute an equilibrium. We need to check for the possibility of corner solutions, since each player has a participation constraint which ensures that playing the game is at least as profitable as not playing. For the participation constraints, see the Appendix.

²⁷ Spending at trial with respect to the defendant's negligence is increasing both in the productivity parameter and the size of the judgment and decreasing with the degree of plaintiff fault. Further, for a given value of the productivity parameter, the amount at stake and the degree of plaintiff fault, the parties spend most when the defendant degree of fault equals $\frac{1}{2}$.

$$X_1^* = Y_1^* = F_1(1 - F_1)(1 - F_2)$$

Under comparative negligence, the parties' expenditures regarding the defendant's negligence equal

$$X_1^* = Y_1^* = F_1(1 - F_1)(1 - F_2) + F_1(1 - F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right]$$

We can easily see that the expenditures regarding the defendant's negligence are larger under comparative negligence than under contributory negligence, since

$$F_1(1 - F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right] > 0. \text{ The reason is twofold. First, the expected value of}$$

expenditures regarding the defendant's negligence is lower under contributory negligence, since these have zero value when the plaintiff is also held negligent. Second, additional investments can lead the court to conclude that the defendant's negligence is relatively large (or small). Under contributory negligence, the degree of negligence doesn't matter for the ultimate division of the loss. Under comparative negligence, it matters a great deal, because the relative degree of negligence influences the division of the loss.

3.2. Expenditures regarding the plaintiff's negligence

Under contributory negligence, the parties' expenditures regarding the plaintiff's negligence equal²⁸

$$X_2^* = Y_2^* = F_1F_2(1 - F_2)$$

Under comparative negligence, the parties' expenditures regarding the plaintiff's negligence equal

²⁸ Spending at trial with respect to the plaintiff's negligence is increasing in the productivity parameter, the size of the judgment and the degree of defendant fault. Further, for a given value of the productivity parameter, the amount at stake and the degree of defendant fault, the parties spend most when the plaintiff degree of fault equals 1/2.

$$X_2^* = Y_2^* = F_1 F_2 (1 - F_2) \left(1 - \frac{F_1}{F_1 + F_2} \left(1 - \frac{F_2}{F_1 + F_2}\right)\right)$$

We can easily see that the expenditures regarding the plaintiff's negligence can be either larger or smaller under comparative negligence than under contributory negligence. The expenditures can be smaller under comparative negligence because the expected value of expenditures regarding the plaintiff's negligence is lower under comparative negligence. If the plaintiff is held liable under contributory negligence, he bears the entire loss. Under comparative negligence, he only bears part of the loss. The expenditures can be larger under comparative negligence because additional investments can lead the court to conclude that the plaintiff's fault is relatively small (or large).

3.3. Total expenditures and case quality

The total expenditures are smaller under comparative negligence when:

$$2F_1(1 - F_1)(1 - F_2) + 2F_1F_2(1 - F_2) >$$

$$2F_1(1 - F_1)(1 - F_2) + 2F_1(1 - F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2}\right] +$$

$$2F_1F_2(1 - F_2) \left(1 - \frac{F_1}{F_1 + F_2} \left(1 - \frac{F_2}{F_1 + F_2}\right)\right)$$

After rearranging terms, we find that this condition comes down to:

$$(1 - F_1) \left(1 + \frac{F_2}{F_1 + F_2}\right) < (1 - F_2) \left(1 - \frac{F_2}{F_1 + F_2}\right)$$

This condition is more (less) likely to be fulfilled as $\frac{F_1}{F_2}$ increases (decreases). In other words, the stronger (weaker) the plaintiff's case²⁹, the more likely it is that expenditures are smaller (larger) under comparative negligence than under contributory negligence. Take for the example the case in which $F_1=0.8$ and $F_2=0.2$. Then the condition is clearly fulfilled ($0.4 < 0.64$). In the case in which $F_1=0.2$ and $F_2=0.8$, the condition is not fulfilled ($1.44 > 0.04$).

The intuition behind this finding is the following. First, when the true level of fault of the defendant increases, the importance of the outcome of the issue of the plaintiff's negligence increases under both rules, but more so under contributory negligence than under comparative negligence. We can easily see this by looking at extreme examples. Suppose the true level of fault of the defendant is equal to zero. Then the defendant will not be held negligent by the court. Under both contributory and comparative negligence, the parties will spend nothing on the issue of the plaintiff's negligence, because it does not matter for the outcome. The plaintiff will bear the loss anyway, since the defendant will not be held negligent. Now suppose the true level of the defendant's fault increases to 1. Then the defendant will be held negligent by the court with certainty. Under contributory negligence, the outcome of the issue of the plaintiff's negligence is now extremely important. Whoever wins this issue, wins the case. Under comparative negligence, the outcome of the issue of the plaintiff's negligence is relatively less important, due to the sharing character of this rule, unlike the all-or-nothing character of contributory negligence. Even if the plaintiff loses this issue, he will still be awarded a fraction of his loss.

Second, when the true level of fault of the plaintiff decreases, the importance of the outcome of the issue of the defendant's negligence increases under both rules, but more so under contributory negligence than under comparative negligence. We can again see this by looking at extreme examples. Suppose the true level of fault of the plaintiff is equal to 1. Then the plaintiff will be held negligent by the court with certainty. Under contributory negligence, the parties will not spend anything regarding the issue of the defendant's negligence, since the plaintiff will bear the loss due to his negligent behavior. Under comparative negligence, the parties will incur expenditures regarding the issue of the defendant's negligence, because the plaintiff can still be awarded a fraction of the loss if he wins this issue. Now suppose the true

²⁹ Taking both the defendant's and the plaintiff's behavior into account.

level of the plaintiff's fault decreases to 0. Then the plaintiff will not be held negligent by the court. Under contributory negligence, the outcome of the issue of the defendant's negligence is now extremely important. Whoever wins this issue, wins the case. Under comparative negligence, the outcome of the issue of the defendant's negligence is also more important, but relatively less so.

Third, the greater the difference between the true levels of fault of the parties, the smaller the value of investing in trying to convince the court that one's level of fault was more modest. The effects of such investments are more heavily discounted when the difference between the levels of fault is relatively large.³⁰

These findings may explain an empirical result from Low and Smith (1995). They find that on average, the comparative negligence standard produces greater incentives to file a lawsuit, but also that as claimant negligence increases, the incentives to litigate on the margin are stronger for claimants in contributory negligence settings. Low and Smith explain this last result by appealing to the view that litigation is sometimes used as a variance-increasing strategy. Incentives to employ such a strategy may have been reduced by the trend to adopt comparative negligence. The model in this article shows that rent seeking expenditures may provide an alternative or complementary explanation for this phenomenon.

4. Conclusion

Litigation expenditures can be either smaller or larger under a rule of comparative negligence than under a rule of contributory negligence. The differences between both rules can be summarized as follows. First, comparative negligence increases the expenditures of the parties because the expenditures may influence the court's view on the relative degree of negligence,

³⁰ A simple example can illustrate this. Suppose we can represent the level of fault of the plaintiff by the number 0.2, and the defendant's level of fault by the number 0.8, and that the court uses the following formula to determine the plaintiff's share: $0.8/(0.8+0.2) = 0.8$. Now suppose the defendant can make an investment i that will reduce his level of fault (as ultimately perceived by the court) with 0.1 ($0.8-0.1=0.7$). Then the plaintiff's share would equal $0.7/(0.7+0.2) = 0.78$. Now we look at a case in which the levels of fault are more close: 0.5 for the plaintiff and 0.8 for the defendant. The plaintiff's share will be $0.8/(0.8+0.5) = 0.62$. Clearly, the investment i , which again reduces the level of fault of the defendant with 0.1, has a greater pay-off for the defendant in such a closer case: $0.7/(0.7+0.5) = 0.58$. So here we get a reduction of 0.04, while in the previous case the reduction was only 0.02. Clearly, there will be more investment in the latter type of cases.

which only matters under comparative negligence. Second, comparative negligence also increases the expenditures regarding the defendant's negligence for another reason. The value of these expenditures is lower under contributory negligence, since these are worthless if the plaintiff is also held negligent. Third, comparative negligence can decrease the expenditures regarding the plaintiff's negligence. If the plaintiff is held liable under contributory negligence, he pays everything. Under comparative negligence, he only bears part of the harm. It thus becomes less worthwhile to fight hard. Total expenditures are more likely to be smaller under comparative negligence as the defendant's degree of fault increases relative to the plaintiff's degree of fault.

Several extensions are possible. For example, instead of looking for the Nash equilibrium, we could look for the Stackelberg equilibrium. Indeed, the parties do not necessarily always choose their strategies simultaneously. In some instances, one side may be able to commit to a level of effort, to which the other side then makes an optimizing response. It would be natural to assume that it's the plaintiff who makes a commitment, since there is no lawsuit unless the plaintiff initiates it.³¹ Another extension could examine the expenditures regarding the defendant's and the plaintiff's negligence in a sequential trial.³² This article assumed trials are unitary. Finally, even in unitary trials, one could introduce the possibility that one party acknowledges his negligence or acknowledges that the other party didn't act negligently, so that only one issue needs to be litigated. One could then analyze under which negligence rule the parties are more likely to do this.

³¹ See Hirshleifer and Osborne (2001).

³² For a comparison of expenditures in unitary versus sequential trials, see De Mot, Luppi and Parisi (2012), who build further on Landes (1993).

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APPENDIX

I. Interior Nash equilibria

A. Contributory negligence

The plaintiff's expected value equals:

$$EV_{pl} = P_d(1 - P_p) - X_1 - X_2, \text{ thus } EV_{pl} = \frac{X_1 F_1}{X_1 F_1 + Y_1 (1 - F_1)} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1 - F_2)} \right) - X_1 - X_2$$

The expected loss of litigation for the defendant equals:

$$EL_{def} = P_d(1 - P_p) + Y_1 + Y_2, \text{ thus } EL_{def} = \frac{X_1 F_1}{X_1 F_1 + Y_1 (1 - F_1)} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1 - F_2)} \right) + Y_1 + Y_2$$

With respect to the plaintiff's expected value, the first order conditions are:

$$\frac{Y_1 F_1 (1 - F_1)}{(X_1 F_1 + Y_1 (1 - F_1))^2} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1 - F_2)} \right) = 1 \quad \text{and} \quad \frac{X_1 F_1}{X_1 F_1 + Y_1 (1 - F_1)} \frac{Y_2 F_2 (1 - F_2)}{(Y_2 F_2 + X_2 (1 - F_2))^2} = 1$$

With respect to the defendant's expected value, the first order conditions are:

$$\frac{X_1 F_1 (1 - F_1)}{(X_1 F_1 + Y_1 (1 - F_1))^2} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1 - F_2)} \right) = 1 \quad \text{and} \quad \frac{X_1 F_1}{X_1 F_1 + Y_1 (1 - F_1)} \frac{X_2 F_2 (1 - F_2)}{(Y_2 F_2 + X_2 (1 - F_2))^2} = 1$$

From combining these first order conditions, it's easy to see that $X_1^* = Y_1^*$ and $X_2^* = Y_2^*$.

Putting this back in the first order conditions gives us:

$$X_1^* = Y_1^* = F_1(1 - F_1)(1 - F_2); X_2^* = Y_2^* = F_1 F_2(1 - F_2)$$

The plaintiff's expected value reaches a *maximum* in (X_1^*, X_2^*) since the second order conditions are fulfilled:³³

$$\frac{\partial^2 EV_{pl}}{\partial X_1^2} = \frac{\partial^2 P_d}{\partial X_1^2} (1 - P_p) = -2 \frac{F_1^2 (1 - F_1)}{X_1^{*2}} (1 - F_2) = \frac{-2}{(1 - F_1)(1 - F_2)} < 0$$

$$\frac{\partial^2 EV_{pl}}{\partial X_2^2} = -P_d \frac{\partial^2 P_p}{\partial X_2^2} = -2 F_1 \frac{F_2 (1 - F_2)^2}{X_2^{*2}} = \frac{-2}{F_1 F_2} < 0$$

$$\frac{\partial^2 EV_{pl}}{\partial X_1^2} \frac{\partial^2 EV_{pl}}{\partial X_2^2} > \left(\frac{\partial^2 EV_{pl}}{\partial X_2 \partial X_1} \right)^2 \text{ since } \frac{\partial^2 EV_{pl}}{\partial X_1^2} \frac{\partial^2 EV_{pl}}{\partial X_2^2} = \frac{4}{F_1 F_2 (1 - F_1)(1 - F_2)},$$

³³ We can show in a similar way that the defendant's expected loss reaches a minimum in (Y_1^*, Y_2^*) .

$$\left(\frac{\partial^2 EV_{pl}}{\partial X_2 \partial X_1}\right)^2 = \left(-\frac{\partial P_d}{\partial X_1} \frac{\partial P_p}{\partial X_2}\right)^2 = \left(\frac{F_1^* (1-F_1^*)}{X_1^*} \frac{F_2^{*2} (1-F_2^*)}{X_2^*}\right)^2 = \frac{1}{F_1^2 (1-F_2)^2}$$

and $\frac{4}{F_1 F_2 (1-F_1)(1-F_2)} > \frac{1}{F_1^2 (1-F_2)^2}$, thus $4F_1(1-F_2) > (1-F_1)F_2$ whenever the participation constraint of the plaintiff is fulfilled ($F_1 > F_2$, see further at II).

B. Comparative negligence

B.1. First and second order conditions

The plaintiff's expected value equals

$EV_{pl} = P_d(1 - P_p) + P_p P_d \sigma - X_1 - X_2$, thus

$$EV_{pl} = \frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}\right) + \frac{\frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}}{\frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} + \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}} - X_1 - X_2$$

The expected loss of litigation for the defendant equals:

$EL_{def} = P_d(1 - P_p) + P_p P_d \sigma + Y_1 + Y_2$, thus

$$EL_{def} = \frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} \left(1 - \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}\right) + \frac{\frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}}{\frac{X_1 F_1}{X_1 F_1 + Y_1 (1-F_1)} + \frac{Y_2 F_2}{Y_2 F_2 + X_2 (1-F_2)}} + Y_1 + Y_2$$

With respect to the plaintiff's expected value, the first-order conditions regarding the defendant's negligence and the plaintiff's negligence are:

$$\frac{\partial P_d}{\partial X_1} (1 - P_p) + P_p \frac{\partial P_d}{\partial X_1} \sigma + P_p P_d \frac{\partial \sigma}{\partial X_1} = 1, \quad \text{thus} \quad \frac{\partial P_d}{\partial X_1} (1 - P_p) + P_p \frac{\partial P_d}{\partial X_1} \frac{P_d}{P_d + P_p} + \frac{P_p^2 P_d}{(P_d + P_p)^2} \frac{\partial P_d}{\partial X_1} = 1 \quad (1)$$

$$-P_d \frac{\partial P_p}{\partial X_2} + \frac{\partial P_p}{\partial X_2} P_d \sigma + P_p P_d \frac{\partial \sigma}{\partial X_2} = 1, \quad \text{thus} \quad -P_d \frac{\partial P_p}{\partial X_2} + \frac{\partial P_p}{\partial X_2} P_d \frac{P_d}{P_d + P_p} - \frac{P_p P_d^2}{(P_d + P_p)^2} \frac{\partial P_p}{\partial X_2} = 1 \quad (2)$$

With respect to the defendant's expected loss, the respective first-order conditions are:

$$\frac{\partial P_d}{\partial Y_1}(1-P_p) + P_p \frac{\partial P_d}{\partial Y_1} \sigma + P_p P_d \frac{\partial \sigma}{\partial Y_1} = -1, \text{ thus } \frac{\partial P_d}{\partial Y_1}(1-P_p) + P_p \frac{\partial P_d}{\partial Y_1} \frac{P_d}{P_d + P_p} + \frac{P_p^2 P_d}{(P_d + P_p)^2} \frac{\partial P_d}{\partial Y_1} = -1 \quad (3)$$

$$-P_d \frac{\partial P_p}{\partial Y_2} + \frac{\partial P_p}{\partial Y_2} P_d \sigma + P_p P_d \frac{\partial \sigma}{\partial Y_2} = -1, \text{ thus } -P_d \frac{\partial P_p}{\partial Y_2} + \frac{\partial P_p}{\partial Y_2} P_d \frac{P_d}{P_d + P_p} - \frac{P_p P_d^2}{(P_d + P_p)^2} \frac{\partial P_p}{\partial Y_2} = -1 \quad (4)$$

We can easily see that $X_1^* = Y_1^*$ and $X_2^* = Y_2^*$. If we put $X_1^* = Y_1^*$ and $X_2^* = Y_2^*$ in (1), we get:

$$X_1^* = Y_1^* = F_1(1-F_1)(1-F_2) + F_1(1-F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right]$$

If we put $X_1^* = Y_1^*$ and $X_2^* = Y_2^*$ in (2), we get:

$$X_2^* = Y_2^* = F_1 F_2 (1-F_2) \left(1 - \frac{F_1}{F_1 + F_2} \left(1 - \frac{F_2}{F_1 + F_2} \right) \right)$$

The plaintiff's expected value reaches a *maximum* in (X_1^*, X_2^*) since the second order conditions are fulfilled:³⁴

$$(a) \frac{\partial^2 EV_{pl}}{\partial X_1^2} < 0 : \frac{\partial^2 EV_{pl}}{\partial X_1^2} = \frac{\partial^2 P_d}{\partial X_1^2} (1-P_p) + P_p \frac{\partial^2 P_d}{\partial X_1^2} \sigma + 2P_p \frac{\partial P_d}{\partial X_1} \frac{\partial \sigma}{\partial X_1} + P_p P_d \frac{\partial^2 \sigma}{\partial X_1^2} < 0$$

$$0 < F_1^3 + 3F_1^2 F_2 + 3F_1 F_2^2 - F_2^4$$

This condition is fulfilled whenever the participation constraint of the plaintiff is fulfilled

$$\left(F_1(1-F_2) + F_1 F_2 \frac{F_1}{F_1 + F_2} - \left(F_1(1-F_1)(1-F_2) + F_1(1-F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right] \right) \right) -$$

$$F_1 F_2 (1-F_2) \left(1 - \frac{F_1}{F_1 + F_2} \left(1 - \frac{F_2}{F_1 + F_2} \right) \right) > 0; \text{ see further at II).}$$

$$(b) \frac{\partial^2 EV_{pl}}{\partial X_2^2} < 0 : \frac{\partial^2 EV_{pl}}{\partial X_2^2} = -P_d \frac{\partial^2 P_p}{\partial X_2^2} + \frac{\partial^2 P_p}{\partial X_2^2} P_d \sigma + 2P_d \frac{\partial P_p}{\partial X_2} \frac{\partial \sigma}{\partial X_2} + P_p P_d \frac{\partial^2 \sigma}{\partial X_2^2} < 0$$

$$-F_1^2 F_2 - F_1 F_2^3 - F_2^3 < 0$$

$$(c) \frac{\partial^2 EV_{pl}}{\partial X_1^2} \frac{\partial^2 EV_{pl}}{\partial X_2^2} > \left(\frac{\partial^2 EV_{pl}}{\partial X_2 \partial X_1} \right)^2 :$$

$$4F_1^6 + 4F_1^5 F_2 + 4F_1^4 F_2^2 + 12F_1^5 F_2^2 + 12F_1^5 F_2^2 + 12F_1^4 F_2^2 + 12F_1^3 F_2^3 + 12F_1^4 F_2^2 + 12F_1^3 F_2^3$$

$$+ 3F_1^2 F_2^4 + 5F_1^3 F_2^4 + 2F_1^2 F_2^5 - 3F_1 F_2^6 - 6F_1 F_2^5 + F_2^6 > 0$$

³⁴ We can show in a similar way that the defendant's expected loss reaches a minimum in (Y_1^*, Y_2^*) .

This condition is fulfilled whenever the plaintiff's participation constraint is fulfilled

$$\left((F_1(1-F_2) + F_1F_2 \frac{F_1}{F_1+F_2}) - (F_1(1-F_1)(1-F_2) + F_1(1-F_1)F_2 \frac{F_1}{F_1+F_2} \left[2 - \frac{F_1}{F_1+F_2} \right]) \right) - F_1F_2(1-F_2)(1 - \frac{F_1}{F_1+F_2}(1 - \frac{F_2}{F_1+F_2})) > 0; \text{ see further at II).}$$

II. Participation constraints

II.1. Contributory negligence

For contributory negligence, the participation constraint for the plaintiff requires that

$$F_1(1-F_2) - F_1(1-F_1)(1-F_2) - F_1F_2(1-F_2) > 0, \text{ thus that}$$

$$F_2 < F_1$$

When the exogenous merits regarding the plaintiff's negligence are larger than the exogenous merits regarding the defendant's negligence, the expenditures of the plaintiff are larger than the expected judgment, creating a negative expected value suit.

The participation constraint for the defendant requires that

$$F_1(1-F_2) + F_1(1-F_1)(1-F_2) + F_1F_2(1-F_2) < 1.$$

The participation constraint of the defendant is always satisfied. This is in line with the literature on pure negligence rules (see e.g. Farmer and Pecorino, 1999; the reason is that for the given "production technology" (the success function), the marginal value of additional expenditures is not large enough to create a negative expected defense for the defendant).

II.2. Comparative negligence

For comparative negligence, the participation constraint for the plaintiff requires that

$$F_1(1-F_2) + F_1F_2 \frac{F_1}{F_1+F_2} - (F_1(1-F_1)(1-F_2) + F_1(1-F_1)F_2 \frac{F_1}{F_1+F_2} \left[2 - \frac{F_1}{F_1+F_2} \right]) - F_1F_2(1-F_2)(1 - \frac{F_1}{F_1+F_2}(1 - \frac{F_2}{F_1+F_2})) > 0$$

A substantial amount of claims are filed under comparative negligence but not under contributory negligence (claims for which the exogenous merits are relatively large for both issues and the exogenous merits regarding the plaintiff's negligence are larger than the exogenous merits regarding the defendant's negligence). On the other hand, some claims are

filed under contributory negligence, but not under comparative negligence (claims for which the exogenous merits are relatively small for both issues and the exogenous merits regarding the plaintiff's negligence are slightly larger than the exogenous merits regarding the defendant's negligence. For these claims, the additional expenditures that comparative negligence creates can make the suit have negative expected value). Overall, more claims are filed under comparative negligence than under contributory negligence.

The participation constraint for the defendant requires that

$$F_1(1 - F_2) + F_1F_2 \frac{F_1}{F_1 + F_2} + (F_1(1 - F_1)(1 - F_2) + F_1(1 - F_1)F_2 \frac{F_1}{F_1 + F_2} \left[2 - \frac{F_1}{F_1 + F_2} \right]) \\ + F_1F_2(1 - F_2)(1 - \frac{F_1}{F_1 + F_2}(1 - \frac{F_2}{F_1 + F_2})) < 1$$

Once again, just as under contributory negligence, the participation constraint of the defendant is always satisfied.